Section 2.1
Right-of-Way Issues

2.1.1 Summary of Approach for Supplemental EIS

2.1.1.1 Updates Since Previous Final EIS

The Preferred Alternative identified in the Final EIS, and the evaluation of the least environmentally damaging practicable alternative identified in the CWA Section 404(b)(1) analysis, was based on a 100-m (328-ft) right-of-way that followed the proposed Alternative D (Final EIS Preferred Alternative) alignment. The right-of-way for Alternative D, as well as that of all the other build alternatives evaluated in the Final EIS, included a 20-m (66-ft) wide median, which was based on UDOT design standards at the time the Final EIS was published, and a 27-m (84-ft) wide buffer area, including a trail.

Following the appellate court decision, the lead agencies reviewed information related to the components of the right-of-way to assess whether narrower widths were reasonable. Among other considerations, the lead agencies reviewed information to document whether the median width was selected, in part, to provide for additional travel lanes in the future, and examined the possibility of constructing an alternative without a berm or future utility corridor. Concerns related to the median and berm are addressed below. For a description of the trail component, see Chapter 1, *Purpose of and Need for Action*, and Section 3.3.4, *Alternatives without a Trail Component or Separate Trail Facility*.

In examining a narrower right-of-way, the lead agencies reviewed information presented in the Final EIS relative to the selection of the right-of-way width for Alternative D (Final EIS Preferred Alternative). The federal lead agencies also reviewed new information that has been developed since publication of the Final EIS and requested that UDOT provide detailed information on design standards and guidelines for all components within the right-of-way of the build alternatives. In addition, the federal lead agencies requested that UDOT analyze alternative right-of-way widths based on reductions in both the median and buffer area widths, and that UDOT assemble information on the roadway footprint (i.e., the area of disturbance within the right-of-way) to evaluate opportunities to further minimize project impacts. This supplemental information is contained in the Legacy Parkway technical memorandum: *Right-of-Way Issues* (right-of-way technical memorandum) (HDR Engineering 2005a) and will be used to assist in the determination of the least environmentally damaging practicable alternative that would be feasible to serve the basic project purpose.

2.1.1.2 Changes since the Draft Supplemental EIS

Since publication of the Draft Supplemental EIS in December 2004, UDOT has updated the analysis of the design of Alternative E. This updated analysis indicated that a larger acreage of wetlands could be avoided under Alternative E as a result of design flexibility (i.e., the opportunity for the design engineer

to modify, consistent with design standards, facility components). Specifically, the Draft Supplemental EIS stated that approximately 6 ha (14 ac) of wetlands in the right-of-way of Alternative E could be avoided through design/build flexibility, which affected the acreage of wetlands impacts presented in Section 2.1.2.4, *Alternative Right-of-Way Widths and Wetlands Impact Evaluation*. The updated analysis conducted since the Draft was published indicates that approximately 4 ha (10 ac) of wetlands in the right-of-way of Alternative E could be avoided through design/build flexibility, a reduction of 1.6 ha (4 ac). This reflects a reduction in the acreage of wetlands that could potentially be avoided in the Alternative E right-of-way between Parrish Lane and Glovers Lane.

2.1.2 Summary of Right-of-Way Analysis

As a result of the analysis documented in the right-of-way technical memorandum, the proposed overall right-of-way width for the build alternatives evaluated in this Supplemental EIS has been reduced from 100 m (328 ft) to 95 m (312 ft). This overall reduction results from narrowing the open median from the 20-m (66-ft) width presented in the Final EIS to the 15-m (50-ft) width consistent with recent research on roadway geometrics and a revised UDOT design standard for medians. Under UDOT standards, reducing the median to less than 15 m (50 ft) would require that a design exception for a new rural freeway be granted, the placement of a median barrier,[1] and a corresponding alternative water quality treatment method to replace the water quality control functions of the vegetation in the open median. Consistent with the Final EIS, the 95-m (312-ft) right-of-way includes a 27-m (84-ft) buffer area in areas with a berm and a 25-m (81-ft) buffer area in areas without a berm. A reduced 11-m (36-ft) buffer area is proposed in specific areas of the alignment (i.e., where no berm or interchange is present) to avoid sensitive resources, which would reduce the roadway footprint to 80 m (264 ft) within the proposed 95-m (312-ft) right-of-way in these areas. As indicated in the right-of-way technical memorandum, the analysis found that further reductions in the buffer area, even substantial reductions, resulted in only minor savings in overall wetland impacts and would not provide a safe separation between the roadway facility and the multiuse trail users.

The following sections summarize the analysis of the right-of-way issues particular to the median and buffer area components of the proposed build alternatives. Additional information (e.g., design standards and guidelines) regarding the other components of the proposed right-of-way is provided in Section 3.0 of the right-of-way technical memorandum and in the administrative record.

2.1.2.1 Right-of-Way Cross-Section Components in Supplemental EIS

Mainline Components

For the reasons discussed below, all the build alternatives evaluated in the Supplemental EIS are based on a 95-m (312-ft) right-of-way. Tables 2.1-1 and 2.1-2 below provide the applicable design standards and references used for each component within the right-of-way. These tables also identify which components rely on fixed-dimension widths and which fall within a range of acceptable widths. Where a range of widths could be used, rationale is provided for the dimensions selected.

Figure 2.1-1 illustrates the proposed right-of-way cross section with the berm in place (Table 2.1-1), and Figure 2.1-2 illustrates the proposed right-of-way cross section without the berm in place (Table 2.1-2).

[1] *Median barrier* refers to a longitudinal system such as a concrete barrier used to minimize the possibility of an errant vehicle crossing into the path of traffic traveling in the opposite direction.

Table 2.1-1 Legacy Parkway Proposed Right-of-Way Cross-Section Components and Dimensions (with Berm)

Component (Left to Right)	Dimension, m (ft)	Fixed or Variable	Standard/ Reference	Notes
Side slope to right-of-way line	16 m (53 ft)	Variable	UDOT[2]	• Area required to safely transition from clear zone to existing grade. • Side slope must meet UDOT minimum requirements for maintenance and access. As such, side slope varies and depends on height of embankment—1:6 for fill heights less than 1.5 m (5 ft); 1:4 for fill heights between 1.5 m (5 ft) and 3 m (10 ft); and 1:3 for fill heights above 3 m (10 ft). The maximum height of fill that can be accommodated with the 95-m (312-ft) right-of-way without using a retaining wall is 6.5 m (21.4 ft). The minimum height of fill that can be used while allowing for cross pipes is 1.0 m (3.3 ft). (Embankment fill height brings roadway facility above 1,285 m [4,215 ft].)
Clear zone (includes shoulder)	9 m (30 ft)	Fixed	AASHTO[1, 3] UDOT[2]	• *Clear zone* is the unobstructed area beyond the edge of the traveled way that allows for recovery of errant vehicles. • Area includes 3.6-m (12-ft) paved (outside) shoulder. • 1:6 maximum slope.
Travel lanes (southbound)	7 m (24 ft)	Fixed	UDOT[2] AASHTO[1]	• Provides two southbound 3.6-m (12-ft) travel lanes.
Median/Clear Zone	15 m (50 ft)	Fixed	UDOT[2] AASHTO[1, 3]	• Provides safe separation distance for opposing travel lanes, given an open median. • Includes two 1.2-m (4-ft) paved (inside) shoulders. • UDOT standard requires a fixed 15-m (50-ft) median on rural freeways. AASHTO standard recommends a range of 15 m to 30 m (50 ft to 100 ft) for open medians on rural freeways.[5]
Travel lanes (northbound)	7 m (24 ft)	Fixed	AASHTO[1] UDOT[2]	• Provides two northbound 3.6-m (12-ft) travel lanes.
Clear zone (includes shoulder)	9 m (30 ft)	Fixed	AASHTO[1, 3] UDOT[2]	• *Clear zone* is the unobstructed area beyond the edge of the traveled way that allows for recovery of errant vehicles. • Area includes 3.6-m (12-ft) paved (outside) shoulder. • 1:6 maximum slope.

Component (Left to Right)	Dimension, m (ft)	Fixed or Variable	Standard/ Reference	Notes
Buffer area	27 m (84 ft)	Variable	AASHTO, safety, visual screening, noise attenuation	• Buffer width based on height of berm (2.7 m [9 ft], as measured from the roadway surface at its highest point, to provide screening). Berm side slopes (1:2.5 maximum) must meet UDOT standards for maintenance. • Berm location: East side between 500 South and Porter Lane (Woods Cross), west side between Glover's Lane and State Street (Farmington). • Berm length: 5.1 km (3.2 mi) of overall alignment.
Trail	5 m (17 ft)	Variable	AASHTO[4]	• Provides a 2.4-m-wide (8-ft-wide) paved bicycle/pedestrian path with adjacent 1.8-m-wide (6-ft-wide) unpaved equestrian trail. There would be 0.9 m (3 ft) between the trail and right-of-way line.
Total right-of-way width	**95 m (312 ft)**			

Sources:

[1] *A Policy on the Geometric Design of Highways and Streets* (American Association of State Highway and Transportation Officials 2004).

[2] UDOT Standard Drawing DD 4 (Utah Department of Transportation 2005a).

[3] *Roadside Design Guide* (American Association of State Highway and Transportation Officials 2002).

[4] *Guide for Development of Bicycle Facilities* (American Association of State Highway and Transportation Officials 1999).

[5] A *rural freeway* is defined as an arterial highway with full control of access in an area outside an urban setting (American Association of State Highway and Transportation Officials 2004).

Table 2.1-2 Legacy Parkway Roadway Components and Dimensions (without Berm)

Component (Left to Right)	Dimension, m (ft)	Fixed or Variable	Standard/ Reference	Notes
Buffer area	25 m (81 ft)	Variable	AASHTO,[4] safety, visual screening, noise attenuation	• Buffer area provides safe separation between vehicle traffic on the parkway and pedestrians, bicyclists, and equestrians on the trail.
Trail	6 m (20 ft)	Variable	AASHTO[d]	• Provides a 2.4-m-wide (8-ft-wide) paved bicycle/pedestrian path with adjacent 1.8-m-wide (6-ft-wide) unpaved equestrian trail. There would be 0.9 m (3 ft) between the trail and right-of-way line. • Includes 1-m (3.3-ft) trail fill slope where there is no berm.
Total right-of-way width	**95 m (312 ft)**			

Component (Left to Right)	Dimension, m (ft)	Fixed or Variable	Standard/ Reference	Notes

Sources:

1 *A Policy on the Geometric Design of Highways and Streets* (American Association of State Highway and Transportation Officials 2004).

2 UDOT Standard Drawing DD 4 (Utah Department of Transportation 2005a).

3 *Roadside Design Guide* (American Association of State Highway and Transportation Officials 2002).

4 *Guide for Development of Bicycle Facilities* (American Association of State Highway and Transportation Officials 1999).

(Note: Only buffer area and trail dimensions are provided; all other dimensions are the same as Table 2.1-1.)

The following sections summarize the analyses used to determine the minimum median and buffer area widths and to ensure that they were the minimum necessary to meet the basic project purpose.

Frontage Roads

All the build alternatives described in the June 2000 Final EIS and Supplemental EIS would require frontage roads at certain locations to provide access to properties where access would be cut off by implementation of the proposed action. Without such frontage roads, the affected properties would be inaccessible and would not retain any use. These frontage roads would be adjacent to the mainline of the associated build alternative. The locations of the frontage roads are described in Section 2.5, *Descriptions of Alternatives Evaluated in Detail*, of the Final EIS.

In September 2005, at the request of the lead agencies, UDOT prepared a memorandum (Shingleton pers. comm.) describing the components associated with the frontage roads and the standard or reference that was used to determine their widths. As described in the memorandum, each of the proposed frontage roads would be 20-m (66-ft) wide and would include two 3.7-m (12-ft) side slopes, two 3-m (10-ft) clear zones/shoulders, and two 3.4-m (11-ft) travel lanes. Just as the components of the Legacy Parkway mainline were reviewed to evaluate whether a narrower cross section could be developed to reduce impacts on wetlands and other sensitive resources, the design of the frontage roads was reviewed to look for opportunities to reduce the width (Shingleton pers. comm.). Dimensions for each of these components were based on UDOT design standards, which were, in turn, based on national standards and generally accepted engineering and design practices for roadway facilities. As stated in the memorandum, it was determined that 20 m (66 ft) was the minimum width for the frontage roads that would reflect state and federal design standards.

It should be noted that the width of the frontage roads would be in addition to the 95-m (312-ft) right-of-way width attributed to the build alternative alignments. All evaluations conducted for the Final EIS and the Supplemental EIS considered and disclosed the environmental impacts that would be associated with construction of the frontage roads.

2.1.2.2 Median Width Evaluation

Median Width: Approach

To determine whether a narrower median could be proposed that would still meet the project purpose, the following approach was used.

- Review state and national design standards and guidelines.
- Review recent and relevant safety studies.
- Evaluate alternative water quality control methods to replace the stormwater treatment functions of vegetated filter strips in the 15-m (50-ft) open median. (Vegetated filter strips are described in Section 4.10.3.2, *Surface Water Quality*, of this Supplemental EIS.)

See Section 2.1.2.4 for additional information on the impacts associated with a variety of median widths.

As a related matter, the right-of-way width evaluation considered whether the 20-m (66-ft) median width of Alternative D (Final EIS Preferred Alternative) might be used to accommodate future travel lanes that were mentioned in the Corps's 404(b)(1) evaluation report. Future travel lanes are neither proposed nor reasonably foreseeable for the Legacy Parkway project. (See Section 3.2.2 for a discussion of the Legacy Parkway Beyond Four Lanes Alternative that was evaluated and eliminated from further consideration.)

Design Standards and Guidelines Review

Review of State of Utah and national design standards and guidelines for roadway facilities similar to Legacy Parkway published after the Final EIS (2000) revealed that there were some changes in the design standards recommended for a minimum median width without the use of a median barrier. In February 2005, after publication of the Final EIS, UDOT updated its Standard Drawing DD 4 (Geometric Design for Freeways) to show a fixed width of 15-m (50-ft) for open medians to reflect recent research on roadway geometrics.[2] The 15-m (50-ft) open median is supported by guidelines in *A Policy on the Geometric Design of Highways and Streets* (Green Book) from the American Association of State Highway and Transportation Officials (AASHTO) (2004) and the *Roadside Design Guide* (American Association of State Highway and Transportation Officials 2002) and several safety studies.

The Green Book provides guidance to the designer by referencing a recommended range of values for critical highway dimensions, including median width. Recommending a range of values provides designers with the flexibility to use best professional judgment in determining the appropriate dimensions for a highway, taking into consideration the context, location, and setting of the project. The Green Book recommends that median widths on rural freeways (similar to Legacy Parkway) be between 15 m and 30 m (50 ft and 100 ft).[3] The 15-m (50-ft) median provides for 1.2-m (4-ft) shoulders, 1:6 foreslopes, and a 1-m (3-ft) median ditch, all of which provide adequate space for vehicle recovery. The determination of open median width is based on safety and the best professional judgment, using AASHTO guidance.

The *Roadside Design Guide* presents the state-of-the-practice information on roadway safety based on current accident and research studies.[4] The intent of the *Roadside Design Guide* is to present the concepts of roadway safety to the designer to facilitate selection of the most practical, appropriate, and beneficial roadside design for an individual project. The *Roadside Design Guide* indicates that "a roadside free of fixed objects with stable, flattened slopes enhances the opportunity for reducing accident severity" (American Association of State Highway and Transportation Officials 2002) and that median barriers

[2] The Standard Drawing 815-2 in the Final EIS used a 20-m (66-ft) open median.

[3] The classification of *rural freeway* is appropriate for Legacy Parkway because the parkway is proposed to be located in an area that is currently rural and the proposed parkway would act as a barrier to development in the corridor and would therefore likely abut undeveloped areas (including the Legacy Nature Preserve on the western side of the alignment).

[4] The guidelines for determining median width and/or median barrier application presented in the *Roadside Design Guide* are based on limited analysis of median crossover and research studies. For this reason, UDOT reviewed additional recent research and relevant safety studies to gather information.

should be installed only if the consequences of striking the barrier are expected to be less severe than if no barrier existed. It states that on high-speed, controlled-access roadways with average daily traffic greater than 20,000 vehicles per day (similar to Legacy Parkway), a median barrier is not normally considered for median widths greater than 15 m (50 ft). Safety data indicates that the use of a median barrier generally increases the overall crash accident rate.

Safety Data Review

To further evaluate the guidance in the *Roadside Design Guide* in light of the lack of site-specific data for Legacy Parkway (as it is a new facility), recent research and relevant safety studies were reviewed to analyze the relationship among median width, median characteristics (open median versus median barriers), and safety. The following sources of information were used for the safety data analysis.

- Highway Safety Information System (HSIS) study, *The Association of Median Width and Highway Accident Rates* (Federal Highway Administration 1993). This study is based on a multi-state safety database with accident, roadway inventory, and traffic volume data for a select group of states, including Utah.

- National Cooperative Highway Research Program (NCHRP) study *Improved Guidelines for Median Safety Report* (National Cooperative Highway Research Program 2004).

- *Public Roads* "Low-Cost Solutions Yield Big Savings" (Zeits 2003).

- Utah Accident Data, UDOT Maintenance Division database (Highway Reference System Volumes I and II, 1995) and Roadview Explorer (photo log) (Utah Department of Transportation 1995).

- New Jersey Accident Data (New Jersey Department of Transportation 2003).

The 1993 FHWA study (*Association of Median Width and Highway Accident Rates*) stated, "...the total accident rate appears to decline steadily with increasing median width." The study also mentions that medians that are 15 m (50 ft) wide are much safer than a narrower median. The study states, "…in the design of new highways, our findings would support medians considerably wider than 30 to 40 ft (9.2 to 12.2 m)."

The NCHRP study (*Improved Guidelines for Median Safety Report* [2004]) provides improved guidelines for using median barriers and selecting median widths on newly constructed and reconstructed high-speed roadways as referenced in the *Roadside Design Guide*. The report evaluated median safety using cross-section data, roadway inventory data, and data on crashes within medians. The study states that, although median width designs vary from state to state, they are based on safety studies indicating that medians narrower than 13.7 to 15 m (45 to 50 ft) are not safe without a barrier. One of the conclusions drawn from the NCHRP study is that increasing median widths on divided, limited-access highways decreases crash frequency.

The FHWA publication *Public Roads* featured an article on fatality rates on South Carolina's interstates (Zeits 2003). The article, "Low-Cost Solutions Yield Big Savings," examined South Carolina's approach to addressing median-related traffic fatalities. Based on the article, the South Carolina Department of Transportation (SCDOT) decided to install barriers on medians less than 18 m (60 ft). SCDOT determined that wider medians were safer than narrow medians.

UDOT also reviewed safety data collected on existing freeway systems in Utah (Interstates 15, 215, 70, and 80). Data from the UDOT Maintenance Division database and the UDOT roadway photo log were

reviewed, and a visual inspection of the urban freeways in the Salt Lake area was performed to determine the locations of concrete barrier medians. The accident reports described the accident type, number of vehicles involved, accident severity, object struck, collision type, date, and other accident information. The findings of this study indicate that the average total accident rate (1997–2001) is 1.29 accidents per million vehicle-miles traveled (VMT) for roadway sections with a barrier and 0.67 accidents per million VMT for sections without a barrier.

The safety studies and median-related accident data analyzed resulted in the following conclusions regarding the relationship among median width, median characteristics, and safety. For more detailed information regarding these studies, see Section 3.0 and Appendices B and C of the right-of-way technical memorandum (HDR Engineering 2005a).

- Total accident rate appears to decline steadily for open medians on divided, limited access highways as the median width increases.
- While the use of a median barrier can reduce the required median width, safety data indicate that the use of median barriers generally increases overall accident rates because of the reduced recovery area for errant vehicles and the introduction of a fixed object (barrier).
- Research on median safety does not definitively identify 15 m (50 ft) as preferable over other widths. Rather, the research supports an open median width of 15 m (50 ft) or greater for new facilities rather than a median barrier.

Alternative Water Quality Control Methods Evaluation

The original June 2000 Final EIS and CWA 404(b)(1) evaluation was based, in part, on treating stormwater runoff on a 20-m (66-ft) open vegetated median (referred to as a "vegetated filter strip" in Section 4.10.3.2, *Surface Water Quality*, of this Supplemental EIS and referenced in Figures 2.1-1 and 2.1-2). This open vegetated median provides a portion of the required compliance with state water quality standards (i.e., removal of 80 percent of the total suspended solids [TSS] in the stormwater runoff) that is required to ensure that state numeric water quality standards are not exceeded. Additional water quality control treatment is provided by side slopes, as shown on Figures 2.1-1 and 2.1-2.

The right-of-way technical memorandum evaluated the effectiveness of alternative water quality control methods in meeting required state water quality treatment standards. The analysis included a complete comparative evaluation of alternative median widths, including the proposed 15-m (50-ft) open median and an 8-m (26-ft) median, although the 8-m (26-ft) median would not be allowable under current UDOT design standards for new rural freeways.[5] The analysis determined that any median less than 15 m (50 ft) would require placement of a median barrier as required by UDOT for a new facility. Replacing this open median (vegetated filter strip) with a median barrier to reduce the overall median width would require implementation of at least one of the following alternate water quality treatment methods in conjunction with a median barrier to provide the same level of water quality treatment for stormwater runoff as the vegetated filter strips in the proposed open median.

- Detention basins with oil/gas skimmers.

[5] The 8-m (26-ft) width was selected for the analysis because, at the time of the initial evaluation, it was the narrowest width for a median with a barrier allowable under UDOT design standards. In February 2005, UDOT design standards were revised to reflect a fixed 15-m (50-ft) required open median width, making the narrower 8-m (26-ft) width incompatible with current UDOT design standards.

- Retention basins.
- Sediment traps/basins.

These alternative water quality treatment methods were evaluated for their ability to adequately treat stormwater runoff (80 percent removal of TSS). The required acreage of the basins, long-term maintenance requirements, and other additional potential impacts on groundwater and hydrology were also considered. Table 2.1-3 compares the proposed 15-m (50-ft) vegetated filter strips in the open median with detention basins with oil/gas skimmers, retention basins, and sediment traps/basins. (See Section 3.0 of the right-of-way technical memorandum for a more detailed discussion.)

The analysis showed that the proposed reduction of the median to a 15-m (50-ft) open vegetated median (vegetated filter strip) could still provide adequate stormwater retention to meet the required water quality standards. Within the 15-m (50-ft) median, water would be detained for an average of 3 minutes as it travels perpendicularly to the center of the median, and an average of an additional 10 minutes as it travels longitudinally to catch basins located every 100 m (328 ft). This detention time (approximately 13 minutes) would provide for removal of 80 percent of the total suspended solids (TSS) in the stormwater runoff.

The analysis also found that while removal of 80 percent of TSS could be met by either detention or retention basins, these basin methods would require additional land in the vicinity of the proposed action, which would be comparable to the acreage required for the 15-m (50-ft) open median;[6] would require additional long-term maintenance; and could result in additional detrimental environmental impacts.

[6] Detention and retention basins would result in direct impacts on approximately 0.8 ha (2 ac) of wetlands (see Section 2.1.2.4, *Alternative Right-of-Way Widths and Wetlands Impact Evaluation*).

Table 2.1-3 Summary of Impacts of Alternative Water Quality Control Methods

Water Quality Treatment Method	Hydraulic System	Average Treatment Efficiency for Total Suspended Solids Removal	Total Land Required[1]	Other Impacts[2]
Open, 15-m (50-ft) vegetated median (vegetated filter strip)	Sheet flow	Meets water quality treatment objectives of 80 percent	364 ha (900 ac) (ROW)	None
Detention Basins (applicable only for use with median barrier)	Concentrated discharges (Stormwater runoff is detained in basins and discharged to surrounding areas)	Meets water quality treatment objectives of 80 percent	363 ha (898 ac) (356-ha [880-ac] ROW plus 7 ha [18 ac] for detention basins) • Total area requiring treatment with detention basins is approximately 18 ha (44 ac). The remaining portions of the highway would use overland flow through vegetated side slopes and existing ground on outside edges of roadway. • Detention basins could be no deeper than 1 m (3 ft) because of high groundwater table in area. • Based on estimates of runoff quantities and required detention time, about 7 ha (18 ac) of detention basin area would be required (calculated using a 50-yr design storm) for the ROW. • Assuming a detention basin every 305 m (1,000 ft) along the length of the roadway results in 45 basins of about 0.16 ha (0.4 ac) each (see Section 3.3.3, *Area Required for Detention Basins*, in the right-of-way technical memorandum).	Due to the flat nature of land in the study area, open channels or drainage ditches would be required rather than pipelines to collect and convey stormwater to detention basins. These open channels or drainage ditches could • result in draining surface and near surface (shallow) groundwater, which could drain wetlands and lower the groundwater table in the vicinity of the ditches. • encourage the growth and dispersal of invasive species.

Water Quality Treatment Method	Hydraulic System	Average Treatment Efficiency for Total Suspended Solids Removal	Total Land Required[1]	Other Impacts[2]
Retention Basins (applicable only for use with median barrier)	No discharge (water remains in retention basins)	Exceeds water quality treatment objectives of 80 percent (no discharges associated with retention basins)	More than 363 ha (898 ac) (356-ha [880-ac] ROW plus more than 7ha [18 ac] for detention basins) • Retention basins could be no deeper than 1 m (3 ft) because of high groundwater table in area • Assumes more than 45 basins because greater capacity requirements are necessary to retain all stormwater runoff (see Section 3.3.3, *Retention Basins*, in the right-of-way technical memorandum).	See detention basin impacts for similar impacts of open channels or drainage ditches required to collect and convey stormwater to retention basins.
Sediment Traps/Basins	Discharges after water is retained for a period of time to allow sediment to settle.	Sediment traps/basins trap sediment but do not achieve 80 percent TSS removal	363 ha (898 ac) (356-ha [880-ac] ROW plus more than 7 ha [18 ac] for sediment traps/basins)	See detention basin impacts.

Notes:

[1] Includes acreage for right-of-way and additional acreage for detention or retention basins, as applicable. Acreage calculations for the open vegetated median are based on a 95-m (312-ft) right-of-way, which includes the 15-m (50-ft) open median, and acreage calculations for the detention and retention basins are based on an 87-m (285-ft) right-of-way, which includes an 8-m (26-ft) closed median.

[2] Wetlands impacts are described in Section 2.1.2.4, *Alternative Right-of-Way Widths and Wetlands Impact Evaluation.*

Summary of Results of Median Width Evaluation

As a result of the median width analysis, the proposed median width for the build alternatives evaluated in the Supplemental EIS has been reduced from the Final EIS median width of 20 m (66 ft) to 15 m (50 ft) based on updated UDOT Standard Drawing DD 4 (Geometric Design for Freeways). This 15-m (50-ft) median reflects the revised UDOT design standard for open medians on rural freeways, which is consistent with state and national design standards and guidelines. The safety studies analyzed were consistent with median width guidance and design standards used by AASHTO and relied on by UDOT in selecting a 15-m (50-ft) open median width for the proposed build alternatives. This median width is intended to provide a safe separation (without a barrier) of traffic and an adequate vehicle recovery area consistent with UDOT standards. It is also within AASHTO's recommended range for medians on rural freeways (Table 2.1-1). Any median less than 15 m (50 ft) would not reflect the fixed median width UDOT design standard for rural freeways.

The 15-m (50-ft) median is based on safety study findings indicating that, although employing a median barrier can reduce the median width, median barriers generally increase overall accident rates compared to open medians. Safety study review showed that, in general, accident rates decrease as median width increases. The alternative water quality control method evaluation determined that reducing the median below 15 m (50 ft), which would necessitate the use of a median barrier and eliminate the vegetated median, would require the use of detention or retention basins, which could result in 0.8 ha (2 ac) or more of wetlands impacts. In effect, reducing the median further such that a median barrier and alternative water quality method is necessary (although not within UDOT design standards) would result in environmental impacts similar to or greater than the proposed 15 m (50 ft) open median. The wetland impacts associated with reducing the median width are described in Section 2.1.2.4, *Alternative Right-of-Way Widths and Wetlands Impact Evaluation*.

2.1.2.3 Buffer Area Width Evaluation

To determine whether a narrower buffer area, capable of meeting the basic project purpose, could be incorporated into the proposed right-of-way, the following approach was used.

- Describe and clarify the purpose of the buffer area.
- Review design standards and guidelines.
- Consider public scoping comments regarding buffer area.

Description and Clarification of Buffer Area Purposes

For purposes of this section, it is important to identify the distinct purposes of the buffer and berm. The federal lead agencies requested that UDOT evaluate and clarify the purpose of the buffer and berm area to facilitate selection of an appropriate width, particularly given variable design guidance relative to buffer areas (see *Design Standards and Guidelines Review* below). As described in the right-of-way technical memorandum, the buffer area would provide a buffer between the trail and the roadway's clear zone outside the travel lanes and is proposed for the full length of the proposed build alignments. As such, the buffer area serves the following purposes.

- Safe separation between the roadway and pedestrians, bicyclists, and equestrians on the trail.
- Visual and acoustic buffer between the roadway and the adjacent trail and land uses.

Within this buffer area, two separate berms (totaling 5.1 km [3.2 mi]) are proposed to provide additional visual and acoustic buffering along the east side between 500 South and Porter Lane in West Bountiful, and along the west side between Glovers Lane and State Street in Farmington. (See Figure 2.1-3 for berm locations along Alternative E.) The berm is intended to provide visual buffering for future planned development in Farmington, and for existing and future planned development in West Bountiful. It is also intended to provide acoustic buffering for future planned development at both locations. Berms are included in the proposed right-of-way to address the desires of the Cities of Farmington and West Bountiful for a landscaped, natural visual and acoustic barrier at the above noted locations. Public comments expressed a desire for the proposed parkway project to provide these benefits to their communities during the public comment periods for both the Final EIS and the Supplemental EIS. Providing a berm in these locations along with a parkway type setting would help compensate the local communities for impacts of the project.

Providing for a future utility corridor is not a purpose of the buffer area. In response to the court's concern as to the practicability of a right-of-way without a future utility corridor (assumed to be within the buffer area), the right-of-way technical memorandum states that no utility corridor is proposed or planned as part of the Legacy Parkway project, and the dimensions of the buffer area were not selected to accommodate the placement of utilities in the right-of-way. Although Figure 2-9 in the Final EIS identified the buffer area as a "potential future utility corridor," the dimensions of the buffer area were established to accommodate the berm rather than a utility corridor.[7] Further, the dimensions of the buffer area would not be affected by the inclusion of a utility corridor if one were proposed. In fact, a utility corridor could be placed within almost any component of the right-of-way (clear zone, median, trail, etc.) and would not affect the overall right-of-way width.

Buffer Area Width: Evaluation

AASHTO's *Guide for Development of Bicycle Facilities* (1999) was referenced for guidance regarding the appropriate buffer width between the proposed Legacy Parkway and multi-use trail. AASHTO recommends a "wide separation" between shared-use paths and adjacent highway facilities but does not provide a fixed minimum dimension design standard for an acceptable separation. Similarly, neither UDOT nor other state departments of transportation consulted during preparation of the right-of-way technical memorandum have specific numeric design standards or guidelines for separating trails from adjacent highways.

In the absence of fixed or variable numeric design standards, the appropriate minimum buffer area width was selected by UDOT using best professional judgment and accepted by the lead agencies to attain the following goals.

[7] Administrative Rule R930-6 requires UDOT to allow utility lines on public rights-of-way. The Jordan Valley Water Conservancy District and the Weber Basin Water Conservancy District have identified a 64-km (40-mi) pipeline in their long-range plan (to be completed in 15–20 years). However, there is currently no proposal or formal request to build this pipeline, and this pipeline is not considered to be part of the Legacy Parkway project. If a utility corridor were proposed in the future for placement in the right-of-way, the impacts of the action would be fully disclosed and analyzed. This issue is discussed at length in Responses to Comments in the Final EIS (Letter 842, comments 201 and 206).

- Provide a safe separation between the roadway facility and multiuse trail.
- Provide adequate visual screening and acoustic (traffic noise) buffering.
- Contribute to a "parkway" type project in keeping with the desires of local communities and with UDOT's commitment to CSS principles. (See Chapter 1 for discussion of CSS.)
- Use CSS principles to provide the trail as an asset to the community while minimizing impacts on sensitive resources.

For all build alternatives evaluated in the Supplemental EIS, the proposed buffer area would have the following characteristics.

- 25 m (81 ft) in areas without a berm (17.4 km [10.2 mi] of the alignment).
- 26 m (84 ft) in the remaining 5.1 km (3.2 mi) of the alignment where a berm would be located.
- A minimum 11-m (36-ft) buffer area in areas where the roadway facility crosses sensitive resources (and where there is no berm or interchange). [8]

All cross sections use a 4-foot chain-link fence between the buffer area and roadway facility to separate the buffer area and trail from motorists. A reduced buffer of a minimum of 11 m (36 ft) would be used to position the footprint within the 95-m (312-ft) right-of-way to avoid sensitive resources where engineering and design constraints allow (estimated to be used on up to 3.2 km [2 mi] of right-of-way based on locations of berms and interchanges). Figure 2.1-4 illustrates the reduced footprint that results from reducing the buffer area width. This reduced footprint is part of a proposed design-bid-build approach and is consistent with UDOT's policy on CSS. Even though the use of an 11-m (36-ft) buffer lessens the advantages of the buffer described above, this tradeoff minimizes impacts on sensitive resources to the greatest extent practicable. Many of the advantages of the buffer area would remain, although slightly reduced. A similar approach would be applied to construction of the trail, placing the footprint of the trail outside and around the edges of wetlands. It is important to note that while the right-of-way would not be reduced in these areas (i.e., it would remain at the 95-m (312-ft) right-of-way analyzed in this Supplemental EIS), the footprint impacts would be reduced to an 80-m (264-ft) footprint. As a result of this design-bid-build approach, direct impacts on wetlands associated with Alternative D and E right-of-way options could be reduced by approximately 0.8 ha (2 ac) with the limited application of this reduced 11-m (36-ft) buffer width (see Section 2.1.2.4 below).

2.1.2.4 Alternative Right-of-Way Widths and Wetlands Impact Evaluation

As described in Sections 2.1.2.2 and 2.1.2.3, the proposed right-of-way width for Alternative E evaluated in the Supplemental EIS is 95 m (312 ft). This width reflects a 5-m (16-ft) reduction from the right-of-way width of Alternative D (Final EIS Preferred Alternative). Impacts on the wetlands within the right-of-way have been reduced from 46 ha (114 ac) for Alternative D (Final EIS Preferred Alternative) to 45 ha (113 ac) for Alternative E in the Supplemental EIS. To determine whether wetland impacts could be

[8] In the Great Salt Lake and the D&RG regional corridor alternatives analysis, this reduced footprint was used to minimize impacts on wetlands, Section 4(f) resources, and homes.

reduced by further narrowing the median and/or buffer areas, the federal lead agencies requested that UDOT evaluate additional right-of-way widths, as described in Table 2.1-4. Cross sections for these alternative right-of-way widths are provided in Figure 2.1-5. It should be noted that the wetland impacts presented in this section are based on the Alternative D and E alignment, which is described in Chapter 3 of this document.

Compared to the alternatives evaluated in the Final EIS, all the evaluated alternative right-of-way widths represent a reduction in the median width, the buffer area width, or a combination thereof. Slight changes in the side slope dimensions are also included in the alternative right-of-way widths where they depend on the median and berm widths. It should be noted that reductions in the median width to less than 15-m (50-ft) would not be consistent with UDOT design standards; they were evaluated for comparative purposes to evaluate relative impacts on wetlands. In addition, one of the alternative right-of-way widths evaluates the wetlands impacts savings that would be associated with eliminating the multi-use trail, although this alternative would not meet the transportation and community interest objectives for the proposed action. (See Section 1.3.2 and Section 3.3.4 in this document for discussions of the trail and how it is consistent with the primary project purpose). The lead agencies requested that UDOT present the impacts of this alternative for comparative purposes only because the trail meets the primary part of the purpose and need of the project. Based on the court ruling upholding the trail as part of the project purpose and need, the Corps and FHWA have described the trail as a feature of the parkway design without further evaluating alternate alignments without a trail.[9]

The wetland impact evaluation determined that additional reductions in the median and buffer area result in minor reductions in overall direct wetland impacts, but they also result in a loss of safety, visual, and acoustic buffering, as well as additional adverse environmental impacts. Replacing the 15-m (50-ft) open median (vegetated filter strip) with a minimum 8-m (26-ft) median with a barrier and reducing the buffer area from 25–27 m (81–84 ft) to a 3-m (10-ft) landscaped area (refer to the 80-m [261-ft] right-of-way alternative right-of-way width in Table 2.1-4) would reduce direct wetland impacts by approximately 1.2 ha (3 ac).[10] However, detention and retention basins and their associated open channels or drainage ditches (alternative water quality control methods needed to replace the open median function as a vegetated filter strip) result in up to an estimated 0.8 ha (2 ac) of direct impacts on wetlands, with additional environmental impacts on hydrology. Considering wetland acreage within the right-of-way that would be avoided through design flexibility (i.e., 4.0 ha [10 ac] for Alternative E, See Section 4.12.3.1, *Direct Impacts*), wetland impacts associated with the 95-m (312-ft) and the 80-m (261-ft) rights-of-way would be 42 ha (103 ac) and 41 ha (102 ac), respectively. Note that the design flexibility provided by the 80-m (264-ft) reduced footprint within both the 95-m (312-ft) and the 80-m (261-ft) rights-of-way provides the potential to avoid an additional 0.8 ha (2 ac) of wetlands. This could bring the wetland impacts to 41 ha (101 ac) under the 95-m (312-ft) right-of way and 40 ha (100 ac) under the 80-m (261-ft) right-of-way.

2.1.3 Conclusions

As a result of the right-of-way analysis, the proposed overall right-of-way width for the build alternatives evaluated in this Supplemental EIS has been reduced from 100 m (328 ft) to 95 m (312 ft). The right-of-way technical memorandum proposes a 15-m (50-ft) open median, which reflects UDOT design standards

[9] The Corps Record of Decision for the Final EIS Preferred Alternative contains an extensive discussion regarding the need for the trail. Page 64 of the court opinion clearly states: "The COE reasonably concluded that removing the trails was not practicable in light of the project's overall purpose of meeting the transportation needs of the Northern Corridor in 2020, thus the issuance of the permit is not arbitrary and capricious on this basis."
[10] 0.4 ha (1 ac) associated with the median, 0.8 ha (2 ac) associated with the landscaped area.

and is consistent with AASHTO guidelines for open medians on rural freeways. This median width provides three things: a safe separation between opposing traffic lanes, an adequate recovery area for errant vehicles, and adequate stormwater treatment to ensure that state water quality standards are met. Research on median safety supports use of an open median that is at least 15 m (50 ft) wide, rather than a median barrier.

Replacing the 15-m (50-ft) open median with an 8-m (26-ft) narrower median and median barrier (which would not be consistent with UDOT design standards) would reduce impacts on wetlands by 0.4 ha (1 ac). However, reducing the median width would require replacement of the water quality treatment functions associated with the vegetated filter strips through construction of detention or retention basins. Given the topography and shallow groundwater table in the area, it is likely that construction of detention or retention basins could affect up to approximately 0.8 ha (2 ac) of wetlands, which would offset any reduction in wetlands impacts achieved by reducing the median width. In addition, the construction of open drainage channels typically associated with detention basins could affect local hydrology by removing additional amounts of surface water, potentially causing a reduction in the groundwater table and adversely affecting additional acres of wetlands not directly affected by construction of the basins. As a related matter, UDOT does not currently propose or have future plans to propose additional travel lanes in the median of the proposed highway corridor, and additional travel lanes were not a consideration in the selection of the median width for the Final or Supplemental EIS build alternatives.

A 26-m (81-ft) buffer area in areas where a berm is not located and an 11-m (36-ft) buffer area in areas where the roadway crosses environmental resources and neither a berm nor an interchange is located, is proposed for the project. These widths are based on the best professional engineering judgment of UDOT considering local engineering environmental factors such as temperature and precipitation to provide a reasonable, safe separation between the roadway and the trail users, particularly given the lack of definitive numeric national or state guidance on appropriate buffer widths. The design flexibility provided by the 80-m (264-ft) reduced footprint in areas where sensitive resources are present could minimize potential impacts on wetland resources by up to 0.8 ha (2 ac).

A 27-m (84-ft) buffer width in locations where the berm is proposed (e.g., east side of the roadway between 500 South and Porter Lane, and along the west side of the roadway between Glover's Lane and State Street) is proposed for the project. This width is based on a berm height of 2.7 m (9 ft) (as measured from the roadway surface at its highest point), which is the height necessary to visually screen the roadway from a person outside the roadway corridor... Construction of a natural vegetated berm is consistent with local jurisdictions expectations and input received from the public and would contribute to a parkway-type facility. The berm provides visual buffering for existing and future planned development and for future planned development in the locations noted. The proposed buffer area width was not influenced or dictated by the potential to use Legacy Parkway as a future utility corridor, although, as referenced earlier, Administrative Rule R930-6 requires UDOT to allow utility lines on public rights-of-way. If a utility corridor were proposed in the future for placement in the right-of-way, the impacts of the action would be fully disclosed and analyzed.

The results of the right-of-way technical memorandum show that substantial reductions in the median and buffer area result in minor reductions in overall direct wetland impacts, but they also result in a reduction of safety, visual, and acoustic buffering, as well as additional adverse environmental impacts. Reducing the median to the minimum median width of 8 m (26 ft) using a median barrier and reducing the buffer area to a 3-m (10-ft) landscaped area with a noise wall would reduce impacts on wetlands by approximately 1.2 ha (3 ac). However, detention and retention basins and associated channels (alternative water quality control methods needed to replace the open median function as a vegetated filter strip) result in approximately 0.8 ha (2 ac) of direct wetland impacts, with additional environmental impacts on hydrology. Considering wetland acreage within the right-of-way that would be avoided through design

Table 2.1-4 Alternative Right-of-Way Widths Evaluated for Impacts on Wetlands[1]

Right-of-Way Width	Right-of-Way Component: Median	Right-of-Way Component: Buffer Area	Wetlands Located in Right-of-Way, in ha (ac)	Wetland Impacts, in ha (ac)[2]	Comment
100 m (328 ft) Alternative D (Final EIS Preferred Alternative)	20 m (66 ft)	26 m (81 ft) in areas without a berm 27 m (84 ft) in areas with berm	46 (114)	41 (104) Avoids ~4 ha (10 ac) in the interchange areas.	Alternative D (Final EIS Preferred Alternative) right-of-way width, using previous UDOT standard drawing for open median widths. Impacts on an additional 0.8 ha (2 ac) of wetlands could be avoided by using an 80-m (264-ft) footprint in areas with wetlands, bringing wetland impacts from 42 ha (104 ac) to 41 ha (102 ac).
95 m (312 ft) Alternative E	15 m (50 ft)	26 m (81 ft) in areas without a berm 27 m (84 ft) in areas with berm	45 (113)	42 (103) Avoids ~4 ha (10 ac) in the interchange areas.	Right-of-way width based on updated UDOT standard drawing DD 4 for open median widths (Utah Department of Transportation 2004). Impacts on an additional 0.8 ha (2 ac) of wetlands could be avoided by using an 80-m (264-ft) footprint in areas with wetlands, bringing wetland impacts from 41.7 ha (103 ac) to 41 ha (101 ac).
87 m (285 ft)	8 m (26 ft) (median barrier required)	26 m (81 ft) in areas without a berm 27 m (84 ft) in areas with berm	45 (112)	42 (104) Avoids ~4 ha (10 ac) in the interchange areas.	Analyzes the impacts of using the minimum median width allowed under UDOT standards for a “closed” median (e.g., uses pavement with a median barrier). The total wetland impacts shown reflect the 0.8 ha (2 ac) of wetland impacts associated with the construction of alternative water quality control facilities to treat stormwater runoff. These could be offset by the additional 0.8 ha (2 ac) of wetland impacts that could be avoided by using an 80-m (264-ft) design flexibility reduced footprint in areas with wetlands, bringing the total wetland impacts to 41 ha (102 ac).
80 m (261 ft)	8 m (26 ft) (median barrier required)	3 m (10 ft) landscaped area	44 (110)	41 (102) Avoids ~4 ha (10 ac) in the interchange areas.	Analyzes the impacts of using the minimum median width allowed under UDOT standards for a “closed” median (e.g., uses pavement with a median barrier) in addition to a substantially reduced buffer area that incorporates 3-m (10-ft) landscaped area. The total wetland impacts shown reflect the 0.8 ha (2 ac) of wetland impacts associated with the construction of alternative water quality control facilities to treat stormwater runoff . These impacts could be offset by the additional 0.8 ha (2 ac) of wetland impacts that could be avoided by using the 80-m (264-ft) design flexibility reduced footprint in areas with wetlands, bringing total wetland impacts to 100 ac.
71 m (234 ft)	8 m (26 ft) (median barrier required)	Trail and buffer area eliminated	43 (106)	39 (98) Avoids ~4 ha (10 ac) in the interchange areas.	Analyzes the impacts of using the minimum median width allowed under UDOT standards for a “closed” median (e.g., uses pavement with a median barrier) in addition to eliminating the buffer area and multi-use trail. This right-of-way is presented for comparative purposes only (to illustrate the wetland impacts of the trail and buffer area). Eliminating the trail is not consistent with the primary project purpose and does not meet the transportation and community interest objectives for the proposed action. (See Chapter 1 for project purpose.) The total wetland impacts shown reflect the 0.8 ha (2 ac) of wetland impacts associated with the construction of alternative water quality control facilities to treat stormwater runoff, bringing the total wetland impacts from 39 ha (96 ac) to 40 ha (98 ac).

Notes:
This table refers to wetland impacts associated with Alternatives D and E only. Wetland impacts associated with Alternatives A, B, and C of the Final EIS were 44 ha (108 ac), 76 ha (187 ac), and 60 ha (147 ac), respectively. Taking into account the 1–2 ha (2–4 ac) savings associated with a reduced 95-m (312-ft) right-of-way for these build alternatives and 1 ha (2 ac) savings from the 80-m (264-ft) reduced footprint would result in revised wetlands impacts of 41 ha (102 ac) under Alternative A, 73 (181 ha) under Alternative B, and 57 ha (141 ac) under Alternative C. Updated design analysis shows that for Alternative A, reductions associated with final design are approximately 3 ha (8 ac). It would be expected that reductions associated with final design for other build alternatives would be similar to those associated with Alternatives D and E (i.e., an additional 4 ha [10ac]).

[1] See Figure 2.1-5 for cross sections of the alternative rights-of-way.

[2] Figures in this column reflect that the actual roadway facility does not occupy the entire right-of-way, and that as a result, not all the wetlands in the proposed rights-of-way would be directly affected. All alternatives reflect the fact that through final detailed design, UDOT determined that approximately 4 ha (10 ac) of wetlands within the right-of-way, primarily in the north and south interchanges, could be avoided by design-build flexibility.

flexibility (i.e., 4.0 ha [10 ac] for Alternative E, See Section 4.12.3.1, *Direct Impacts*), the 95-m (312-ft) right-of-way would result in 42 ha (103 ac) of wetlands impacts, and the 80-m (261-ft) right-of-way would result in 41 ha (102 ac) of wetlands impacts. Therefore, the acreage of wetlands saved by reducing the median by use of a median barrier, significantly reducing the buffer area, and adding a noise wall would be minimal, if any. Both rights-of-way have the potential for avoiding an additional 0.8 ha (2 ac) of wetlands with the design flexibility provided by the 80-m (264-ft) reduced footprint, which could bring the wetland impacts to 41 ha (101 ac) and 40 ha (100 ac), respectively.

This Supplemental EIS incorporates the following finding of the right-of-way technical memorandum.

> The median can be reduced by 5 m (16 ft), resulting in a reduction in the total right-of-way from the 100-m (328-ft) width presented in the Final EIS to 95 m (312 ft). This 95-m (312-ft) right-of-way width would be used except in areas where wetlands, residences, or Section 4(f) properties can be completely avoided by further reducing the footprint to 80 m (264 ft). The build alternatives evaluated in this Supplemental EIS have been modified to reflect this narrower right-of-way width and the design flexibility provided by the 80-m (264-ft) reduced footprint within the 95-m (312-ft) right-of-way.